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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
A47L 9/20 // B01D 29/70

A1

(11) International Publication Number: **WO 95/34238**

(43) International Publication Date: 21 December 1995 (21.12.95)

(21) International Application Number: PCT/DK95/00241

(22) International Filing Date: 15 June 1995 (15.06.95)

(30) Priority Data:
0687/94 15 June 1994 (15.06.94) DK

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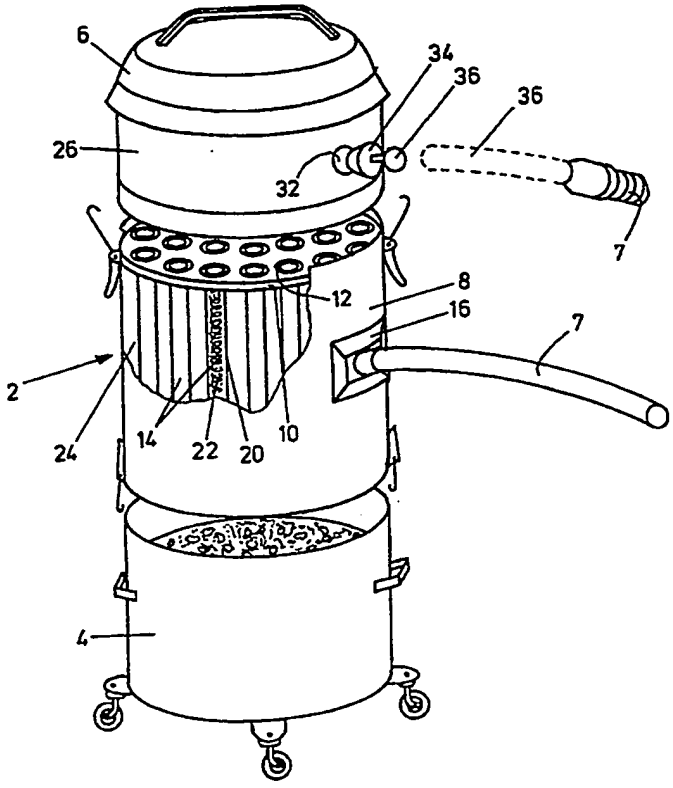
(81) Designated States: AM, AT, AT (Utility model), AU, BB, BG, BR, BY, CA, CH, CN, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.
In English translation (filed in Danish).

(54) Title: A VACUUM CLEANER, PARTICULARLY AN INDUSTRIAL CLEANER, WITH BAG FILTERS

(57) Abstract

In an industrial vacuum cleaner with bag filters are used screw wound distension elements (22) for the filter bags (20). These elements are made as relatively soft springs, which, in operation, will be compressed if filter cakes (30) are formed on the bags, as this will cause an increased air pressure at the exterior dust side of the bags. However, in return the bags will be expanded by a noticeable movement each time the cleaner is stopped, this promoting a rejection of the filter cakes. This effect may be amplified by a sudden opening of a wide valve (34) in the wall of the suction chamber (26) above the filter bags, as the springs will be then straightened out almost impact-like by the associated rapid pressure increase in this chamber.



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A vacuum cleaner, particularly an industrial cleaner, with bag filters.

This invention relates to a vacuum cleaner, particularly an industrial vacuum cleaner, of the type specified in the introductory part of claim 1.

It is known to use bag filters where a high capacity as to suction and dust collection is required. The sucked dust of heavier types will fall down directly into the collector container, while light dust will be sucked against the outsides of the filter bags and remain there until the motor of the cleaner is switched off, whereafter it will fall into the container. The container can be taken out or off for emptying.

It is commonly known that some of the particles sucked against the filter bags have such a size or character that they are liable to stick to the bags, such that they do not fall down in ordinary use of the vacuum cleaner. In time, real filter cakes may thus be formed on the surface of the filter bags, implying a reduction of the efficiency of the vacuum cleaner because it is difficult for the air to penetrate the bag walls.

Normally, such filter cakes have to be removed manually by a mechanical treatment, this work being time consuming. Therefore, different mechanisms have already been developed for effecting a shaking of the bags, some even with separate motors.

The frequency of the required cleaning of the outsides of the filter bags strongly depends of the size of the cleaner and the character of the environment of use. Especially in connection with building works, where there will often be large amounts of very fine particles, the need for cleaning the filter bags will be pronounced, as it is a well known alternative to just continue the cleaning with a noticeably reduced sucti n capacity, or to effect frequent change out of all the

bags.

On this background, it will be advantageous to provide a vacuum cleaner having a filter part made so as to be self-cleaning to a higher degree than usually, such that special mechanisms for cleaning the bags can be avoided and the number of required manual cleanings of the filter can be reduced.

The invention is based on the consideration that an advanced dust choking of the filter bags will result imply a noticeable contraction effect on the bags, as the vacuum inside the bags will be clearly stronger than at the outsides. Normally the distension elements will resist this force, but if they are designed so as to be effectively yieldable by the contraction force, then there will occur a certain working and loosening of rigid cake formations. When the bags or the distension elements are correspondingly resiliently expandable it will be achieved as a main effect that the bags will expand noticeably each time the motor is switched off.

Accordingly, the desired effect is achievable with a machine of the discussed type, which is characterized by the bag filters being featured as specified in the characterizing clause of claim 1.

The invention may be realized already by an extremely simple modification, viz. by selecting distension screw springs of such a softness that these springs are compressed noticeably, e.g. by 5-25%, when a choking is so advanced that a preset limit for an acceptable reduction of the suction capacity has been reached. This will imply that even in the acceptable area there may be some compression for a modest choking, such that already thereby a certain release of filter cake material may take place each time the vacuum cleaner is stopped, i.e. in many cases the filter bags may keep themselves so clean that the said limit will never or seldom be reached.

According to the invention it will be possible to achieve a particularly effective filter cleaning by an abrupt equalization of the pressure difference between the two sides of the filter, such as would be obtainable by a quite sudden stoppage of the suction blower. In that event the filter bags will be expanded impact-like, which will strongly amplify the knocking off. However, it will not be desirable to stop the blower unit in such an abrupt manner, but the same effect is achievable by establishing a short circuiting between the two sides of the filter, by a sudden opening of a wide passage between them, or rather - preferably - by a corresponding sudden opening of a wide hole in the chamber wall between the suction side of the filter and the atmosphere, whereby a pressure equalization to the atmospheric pressure can take place rapidly at both sides of the filter.

If, prior to the last mentioned opening, the free end of the suction hose of the cleaner is blocked, or a stopper is placed in the suction socket of the cleaner or a closing valve at this socket is closed, then the said sudden opening will show the result that while there is a sudden pressure rise on the suction side of the filter, there will be no correspondingly sudden pressure rise on the filter side. Thus, air from the suction side will be sucked the opposite way through the filter, into the filter chamber, whereby during a short period of time the filter bags may be rather strongly counterflushed, this providing for a high cleaning effect.

This effect will be more pronounced, the larger the filter space volume outside the filter bags is, and it may even be desirable to provide the vacuum cleaner with an additional chamber for this purpose, either permanently or as an accessory.

On this background the vacuum cleaner may be provided with a rapidly openable cover over a wide opening in

the wall of the chamber located between the suction blower and the filter, and suitably this cover may have a handle that is additionally usable as a blocking stub for the free end of the suction hose.

In the following the invention is described in more detail with reference to the drawing, in which:-

Fig. 1 is a perspective view of a vacuum cleaner according to the invention,

Fig. 2 is a sectional view of filter bags with distension elements, shown by initial operation,

Fig. 3 is a corresponding view of a filter bag in pronounced choked condition, and

Fig. 4 is a similar view immediately after stoppage of the vacuum cleaner motor.

In Fig. 1 is shown a vacuum cleaner having an intermediate bag filter section 2, a lower collector container 4 for dust, and an upper suction blower section 6. The bag filter section comprises an outer cylindrical wall 8, which is open downwardly towards the container 4, while at its top it has a cover plate 10 provided with a number of holes accommodating downwardly projecting mounting tube stubs 12 for underlying bag filters 14. The wall 8 is provided with a suction stub or socket 16 for a vacuum cleaner hose 18.

So far described the vacuum cleaner is of conventional design. During the operation, air is sucked up from the bag filters, which consist of filter bags or stockings 20 mounted on screw wound distension elements 22 and closed at the bottom, and the suction propagates to the space about the bag filters, i.e. to the filter chamber 24 connected with the suction socket 16. When the air sucked in through the hose 18 enters this chamber the air velocity will be noticeably reduced, and heavier particles in the air will fall down directly into the collector container 4, while lighter particles will be sucked against the outsides of the filter bags

20 and remain there at least until the suction blower in the top section 6 is stopped. Thereby these particles are liberated and free to fall down into the container 4, but as mentioned, over the time some dust accumulation may occur, sticking to the bags as so-called filter cakes. These do not fall down, and in time they may choke the bag walls so widely that the suction capacity of the cleaner is reduced considerably until the bags are cleaned or renewed.

According to the invention the screw wound distension elements 22 are made as semi soft screw springs. As long as the bags are clean this will not make any difference relative to the more rigid elements, as there will only be a low pressure drop across the bag walls; thus, there will be almost the same suction pressure in the filter chamber 24 as in the suction chamber, 26, above the plate 10, whereby even rather soft springs can keep the bags distended, as shown to the left in Fig. 2. In case of an initial choking of the filter walls as indicated at 28 to the right in Fig. 2, a weakened suction pressure will reside in the filter chamber 26, when the choking is general or average for all the bags; this will amount to an overpressure relative to the pressure inside the bags, whereby the lower ends of the springs 22 will be forced slightly upwardly. As soon as the blower motor is switched off the springs will return to their distended condition, optionally even to a pre-biased position inside the fully stretched bags.

By a more pronounced choking the filter bags will be still more compressed, see Fig. 3, where the choking appears as larger cake formations 30. The filter bags will still be straightened out by each stoppage, which, see Fig. 4, will imply that the cakes 30 are influenced to be rejected from the bag walls. It is a contributory effect that the bag walls according to Fig. 3 will assume a pronounced welled shape between the spring

windings due to the reduced distance between these, and by the very straightening from this shape the pronounced change will promote the rejection of the cake formations.

As shown in Figs. 1 and 2, a wide opening 32 may be provided in the wall of the upper suction chamber 26, this opening normally being closed by a cover or stopper 34 having an exterior handle 36. Thus, the wide opening 32 may be opened to the atmosphere by a sudden removal of the stopper 34, whereby, in operation, a sudden pressure increase will take place in the suction chamber 26, such that the springs 22 will expand suddenly and thereby amplify the rejection of the filter cakes 30.

The handle 24 is made as a ball, dimensioned to sealingly receive the free pipe end of the hose 7. By insertion of the pipe end over the ball the suction to the filter chamber will be blocked, whereby the vacuum in this chamber will soon rise to the same as in the upper chamber. When in that situation the stopper 23 is pulled out, this being done easily by the same hand as holding the hose end, then the aforementioned counter flushing effect on the filter bags will occur, as the vacuum in the chamber connected with the hose will be relieved by intake of free air from above.

This effect may be amplified by the use of a lower chamber with an increased volume, e.g. by means of an add-on chamber or by connecting the hose end to a closed box rather than just blocking it.

Optionally, the expansion of the filter bags to the initial shape after each stoppage of the suction blower 8 may be secured by means of resilient pulling connections between the lower ends of the bags and an underlying fixture. Thereby the distension elements need not be resiliently stretchable from the compacted position, and

thus they may consist e.g. of a row of rings held together by easily flexible wires of sewing thread type.

C L A I M S :

1. Vacuum cleaner of the type having a removabl dust collector container located beneath a battery of bag filters mounted on a partition plate in the suction chamber of the vacuum cleaner, said bag filters comprising filter bags mounted on perforated, preferably screw wound distension elements, characterized in that the bag filters are designed to be yieldable in such a manner that in case of the operative air pressure on the filter side of the partition plate becoming higher than that on the filter side thereof the bag filters are resiliently compressible into a state or shape, from which they are straightenable with a noticeable movement in response to a pressure equalisation between the said two sides.

2. Vacuum cleaner according to claim 1, in which the bag filters are dimensioned for a compression of at least 5-10% in case of a strong operative differential pressure.

3. Vacuum cleaner according to claim 1, in which the screw wound distension elements consist of relatively soft screw springs adapted for suitable compression by different degrees of choking of a relevant filter type.

4. Vacuum cleaner according to claim 1, in which the chamber at the suction side of the partition plate, connected with the suction blower, has a wall opening to the atmosphere, this opening being large relative to the capacity of the suction blower and having an instantly openable cover, which, in operation, is openable for producing a sudden and substantial pressure increase in the said chamber.

5. Vacuum cleaner according to claim 4, in which the instantly openable cover (23) is made as a tightly sealing stopper having a handle (24) at its exterior side.

6. Vacuum cleaner according to claim 4, in which there is arranged, at some place of the vacuum cleaner or a driving chassis therefore, a projecting stub or socket member for blockingly receiving the outer end of the vacuum cleaner hose.

7. Vacuum cleaner according to claims 5 and 6, in which the stub or socket member is constituted by the handle of the tightly sealing stopper.

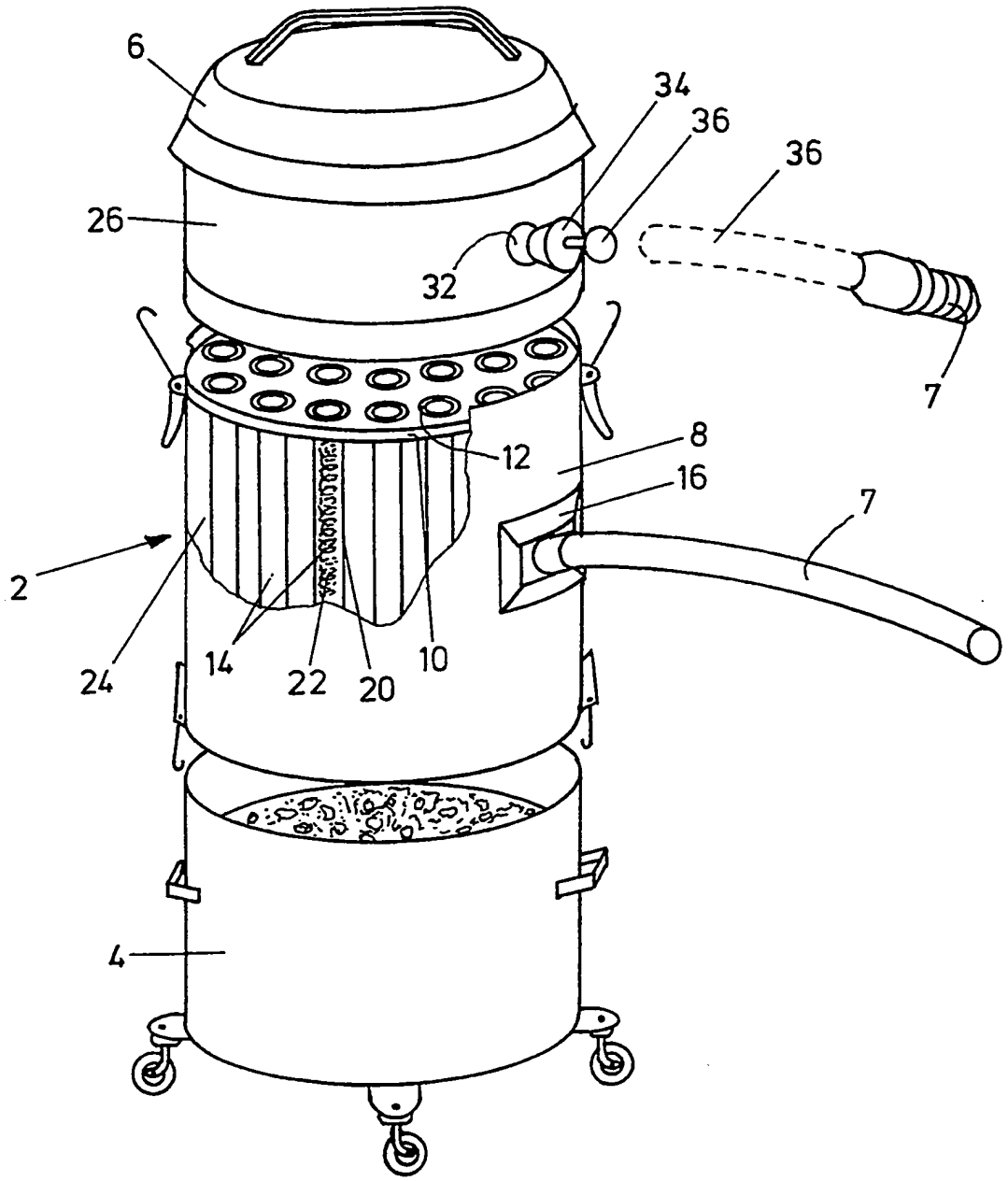

FIG.1

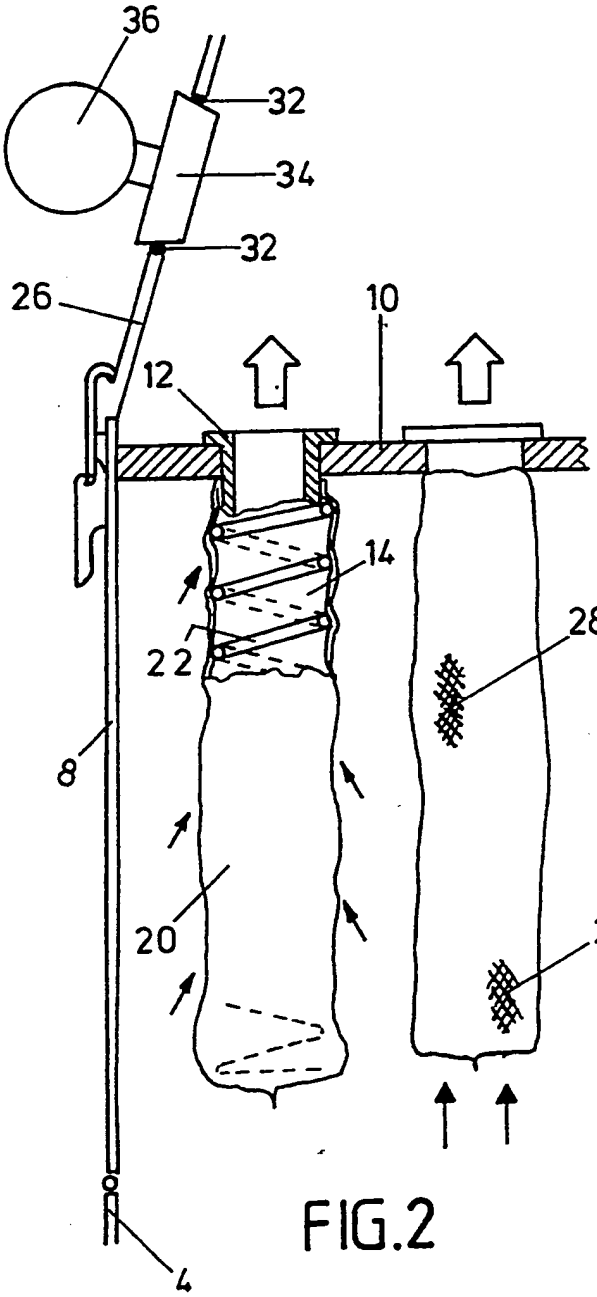

FIG.2

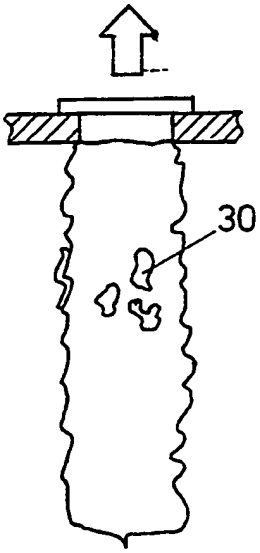

FIG.3

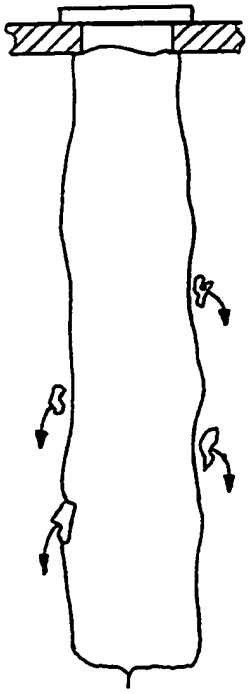

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 95/00241

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A47L 9/20 // B01D 29/70
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3653190 A (LEE ET AL), 4 April 1972 (04.04.72), column 5, line 11 - line 17 --	1-5
Y	US 956862 A (JOHN G. MEYER), 3 May 1910 (03.05.10), column 2, line 3 - line 11 --	1-5
A	GB 410524 A (MCCARDLE, L. F.), 24 November 1932 (24.11.32) --	3
A	SE 337284 C (AB ELECTROLUX), 2 August 1971 (02.08.71) --	1,5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NO 62896 B (JOAKIM LEHMKUHL), 30 Sept 1940 (30.09.40)	6,7

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/DK 95/00241

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3653190	04/04/72	NONE	
US-A- 956862	03/05/10	NONE	
GB-A- 410524	24/11/32	NONE	
SE-C- 337284	02/08/71	NONE	
NO-B- 62896	30/09/40	NONE	